

Information Sheet on Ramsar Wetlands

1. **Date this sheet was completed/updated:** 23 February 2000

2. **Country:** Bolivia

3. **Name of wetland:** Cuenca de Tajzara

4. **Geographical coordinates:**

21 47' 07" South latitude
65 06' 32" West longitude

5. **Altitude:** 3700-4100 metres above sea level

6. **Area:** 5500 hectares

7. **Overview:**

This wetland is in the endorheic Tajzara basin at an altitude of 3700 metres above sea level and is formed by a group of two permanent lakes, three semi-permanent lakes, eighteen seasonal lakes, high-altitude streams, *bofedales* and high-Andean pastures. The two permanent lakes have a surface varying between 350 and 800 hectares and are a refuge for 40 species of birds associated with the high-Andean aquatic ecosystems (representing 90 per cent of the bird species found in the high-Andean aquatic ecosystems). It is an important area for eight species of migratory shorebirds, and there are large year-round concentrations of three species of flamingoes.

The lakes have fluctuating physical and chemical characteristics that explain the presence of many species of micro and macro vegetation.

Most of the fauna is concentrated around the permanent lakes, although in the rainy season, also the period of reproduction, they spread throughout the basin, colonizing other habitats (pastures, *bofedales* and rocky areas) for nesting.

The Cuenca de Tajzara has been part of the Reserva Biológica Cordillera de Sama (RBCS) since 1991 and is a protected area included in the Sistema Nacional de Areas Protegidas, managed by the NGO PROMETA.

8. **Wetland type:** Continental, N, Q, R and U

9. **Ramsar criteria:** 1a, 1c, 2a, 2b, 2c, 3a, 3b

10. **Map of site included?** Please tick **yes** -or- **no**

11. **Name and address of the compiler of this form:**

François-Xavier Dupret
PROMETA (prometa@olivo.tja.entelnet.bo)

Reserva Biológica Cordillera de Sama
Calle Alejandro del Carpio, E-659
Casilla 59
Tarija
Tel./Fax: (591 66) 33873/45865
e-mail: dupretfx@hotmail.com

12. Justification of the criteria selected under point 9, on previous page:

Criteria of representative or unique wetlands (1a, 1c): The Cuenca de Tajzara is an especially outstanding representative example of a natural wetland characteristic of the high-Andean biogeographic region, formed by several lakes and wetlands with different physical and chemical characteristics. It is exceptional to find a group of aquatic habitats with so many different characteristics in such a small area: high-altitude salt lakes without macro vegetation, lakes with a heavy concentration of macro vegetation, *bofedales* and high-altitude streams. For this reason, representatives of more than 90 per cent of the species of aquatic birds present in the high-Andean lakes in Bolivia can be found here (see annex 3).

In addition, this wetland provides important economic services to the communities in the area:

- During the months of extreme drought (July to September), livestock survive by grazing on the macro vegetation in the lakes.
- The areas on the edges of these wetlands are areas of pasture heavily used by sheep.
- The mineral salts concentrated on the shores during the dry season are extracted to exchange for products from other regions.

The Cuenca de Tajzara is an outstanding representative example of a wetland that plays a significant ecological role in the functioning of the system of high-Andean lakes in southern Bolivia, northern Chile and northern Argentina. Several species of aquatic birds found in the Cuenca de Tajzara require specific habitats determined by water level and precipitation. The lakes in the Cuenca de Tajzara attract these species when other high-Andean lakes do not meet their habitat requirements. Many of the other high-Andean lakes in the border region are very vulnerable because they are located near mining centres or near areas with large populations. In February 2000, more than 700,000 hectares of high-Andean wetland in the department of La Paz were damaged by a break in a pipeline. Fortunately, there is no mining or oil extraction activity in the Cuenca de Tajzara.

General criteria based on the fauna and flora (2a, 2b, 2c): The lakes in the Cuenca de Tajzara sustain a large group of species of endangered, vulnerable or rare fauna and flora. There is a recorded frequent presence of vulnerable birds such as the Andean flamingo (*Phoenicopterus andinus*), James's

flamingo (*Phoenicopterus jamesi*) and *Fulica cornuta*. Large groups (200 to 1300 specimens) have often been recorded of *Fulica cornuta* in Laguna Pujzara. On several occasions, almost 2 per cent of the world population of James's flamingo (*Phoenicopterus jamesi*) and 1 per cent of the world population of Andean flamingo (*Phoenicopterus andinus*) have been observed (Dupret 1999c).

Laguna Grande and Laguna Pujzara are especially important for genetic and biological diversity in the region because of the peculiarities of their fauna and flora. The lakes are propitious for the seasonal growth of microphytes and zooplankton, which are fed on by flamingos. Because the lakes have different chemical characteristics, aquatic birds with very special feeding requirements follow changes in microfauna and microflora of each lake and can thus remain year round in the basin.

The Cuenca de Tajzara is especially important as a habitat for plants and animals during a critical stage of their life cycle. These wetlands are home to a large number (eight species) of migratory birds from the north during their migration south. They are also a haven for high-Andean aquatic birds during their search for food. It is an important place for the nesting of species of typical high-Andean birds and is particularly important as an area for the nesting of the *soca gigante* (*Fulica gigantea*), of which there are between 250 and 1000 nests.

Criteria based on aquatic birds (3a, 3b): This wetland is the frequent habitat for a population of 20,000 aquatic birds and sustains significant numbers of specimens of several groups of aquatic birds that are indicators of the importance, productivity and diversity of the wetlands (see annex 2 "List of Birds Recorded in the Reserva Biológica Cordillera de Sama"). Representatives of approximately 40 of the 45 species of high-Andean aquatic birds recorded in Bolivia are found in this basin. This exceptional fact is explained by the presence of a mosaic of very distinct aquatic habitats in a limited area.

13. General location:

The Cuenca de Tajzara is on the Andean plateau, in the second section of the province of Avilés, in the department of Tarija, Bolivia. This wetland is located 45 kilometres from the city of Tarija, one hour and a half away (see annex 1.2). The natural limits of the basin are the Serranía de los Cardenales to the north, the pampas de Copacabana to the south, the Serranías de Sama and Chismuri to the east and the Serranías de Yunchara and Ñoquera to the west (see annex 1.3). The communities whose activities directly affect the site are Arenales, Copacabana, Muñayoj, Pasajes, Pujzara and Vicuñayoj (see annex 1.3).

14. Physical features:

Geology and geomorphology: The Cuenca de Tajzara has an area of 43,770 hectares. This region was subject to heavy volcanic activity during the Tertiary and Quaternary. On the plateau, many hills are of volcanic origin, and the ground is covered with volcanic debris. These hills of volcanic origin reach 1000 to 1500 metres above the plain and usually run north-south, creating many broad valleys, closed basins and wetlands because of a lack of drainage. Sedimentary rocks, sandstone and lutite usually dominate, but there is also limonite that is an important part of the bonding materials (Galarza 1997).

Physiography: The area of Tajzara is distributed in two physiographic provinces: the true foothills and the Puna plateau (the altiplano) with almost flat topography sloping toward the lakes, rivers and streams in the centre of the basin.

Hydrology: The drainage network of the Cuenca de Tajzara is formed by the Río Tajzara, 9.5 kilometres long, the Río Vicuñaoyoj, 14 kilometres, Río Muñaoyoj, 9 kilometres, Río Turcamarca, 8 kilometres and the Río Toro Waykho, 12 kilometres long. The basin is an endorheic basin, which because of its topography forces streams to flow towards the centre, forming the Lagunas de la Cuenca. The upper part of the rivers form *bofedales*. Water level varies considerably, especially in the shallower lakes, because evaporation rates are very high. Two cycles determine the water level:

- An annual cycle, reflecting the annual cycle of precipitation;
- A broader cycle (over four to eight years) tied to the El Niño Southern Oscillation (ENSO). In normal years, the lakes are replenished between November and March.

Soil classification and chemistry: Most of the basin is covered by recent lacustrine-fluvial soils (sandy, sandy-clay, sandy-clay loam). The soil in the *bofedales* is recent lacustrine-fluvial (Galarza 1997).

Water quality, depth, changes in water level and permanence of water: see item 16, "Ecological features".

Climate: According to Holdridge's classification of life zones, the climate of this area is that of a cold temperate steppe. Annual precipitation is 307.2 mm. Average annual temperature is 6.4 °C, with an annual average maximum of 15.0 °C and an average minimum of -2.2 °C. The average maximum extreme is 24.4 °C, and the average minimum extreme is -17.2 °C.

From an analysis of the pattern of precipitation and temperature, it can be learned that a large percentage of rain falls between the months of December and March, creating a light rainy season in summer and dry, cold winters. The temperature pattern is that of a plateau, with an average annual temperature at ground level of 10.4 °C, exactly 4 less than the extreme annual average.

The following figure gives the water balance in the wetland.

Precipitation (mm)
Evapotranspiration (mm)

Distribution of precipitation and evaporation in the Cuenca de Tajzara (average 1983-1992, source SENAMIH).

The physical and chemical characteristics of the lakes reflect large variations in function of the water level and inflow of fresh water.

15. **Hydrological values:** The lakes recharge underground water in the basin.

16. **Ecological features:**

Following the classification established by RAMSAR, the wetland can be divided into four categories: **N** (seasonal/irregular/occasional rivers and streams), **Q** (permanent saline/brackish/alkaline lakes), **R** (seasonal/intermittent saline/brackish/alkaline lakes and flooded areas), **U** (treeless bogs, including bogs with bushes or open bogs, bogs with Graminaea, *bofedales* and low bogs).

N (seasonal/irregular/occasional rivers and streams) - These are rivers that collect water in the high parts of the mountains in the eastern part of the basin and feed lakes on the plateau.

Q (permanent saline/brackish/alkaline lakes) - Laguna Grande (150 hectares in the dry season and 450 hectares in the wet season) - Conductivity: 77,100 microhm/cm; total solids: 110,310 mg/l; alkalinity: 326 mg CaCO₃/l; pH: 6.69; depth: 12 to 100 cm; transparency: 2 to 3.5 (data gathered in November 1999, source CADIMA 1999).

In the dry season, the microphytes are represented by three divisions: Chromophyta with 9 subspecies, Chlorophyta with 4 subspecies and Cyanophyta with 2 subspecies for a total of 16 subspecies. The macrophytes are represented by submerged rhizoflora and rooted macrophytes in the *Potamogeton* and *Ruppia* genera. Macroscopic algae in the genus *Nytella* are also found.

In the areas near the lake, there is a floodplain with an association dominated by *Muhlenbergia fastigiata*. This species tolerates flooding and brackish soils. Species in this association include *Anthobryum triandrum*, *Astragalus micranthellus*, *Atriplex myriophylla*, *Chondrosium simplex*, *Distichlis humilis*, *Ephedra breana*, *Festuca* spp., *Gomphrena meyeniana*, *Junellia pygmaea*, *Paronychia* spp., *Senecio spinosus*, *Stipa leptostachya* and *Tetraglochin cristatum* (Beck 1999).

The zooplankton is made up of only one species, *Boeckella poopoensis*.

In this lake, only nine species of birds have been recorded. It is the lake with the greatest concentration of flamingos (up to 11,000), and large numbers of *Fulica cornuta* have been recorded several times.

Laguna Pujzara (200 hectares in the dry season and 250 hectares in the rainy season) - conductivity: 2650 microhm/cm; total solids: 1635 mg/l; alkalinity: 264 mg CaCO₃/l; pH: 10.1; transparency: between 30 and 45 cm; depth: between 80 and 300 cm (data gathered in November 1999, source CADIMA 1999).

The microphytes are represented by two divisions: Chromophyta with 77 subspecies and Cyanophyta with 14 subspecies. There are two genera of macrophytes: *Myriophyllum* spp. and *Potamogeton* spp. in 80 per cent of the lake. In areas of flooding on the shores of the lake, there is a bed of low grass, *brama* (*Distichlis humilis*). It is a rhizomatous species typical of saline environments. This area is subject to intensive grazing, primarily by sheep who appreciate this species for its taste.

Other species in the association are *Anthobryum triandrum*, *Astragalus ariquepensis*, *A. micranthellus*, *A. peruvianus*, *A. reichei*, *Atriplex myriophylla*, *Chondrosum simplex*, *Conyza artemisiaefolia*, *Distichlis humilis*, *Festuca* spp., *Hypochoeris meyeniana*, *Plagiobotrys congestus* and *Rorippa philippiana* (Beck 1999).

The zooplankton is composed of two species of Copepoda and six species of Cladocera. This lake has considerable biological diversity, including 40 recorded species of waterfowl. It is an important area for the reproduction of high-Andean aquatic birds.

R (seasonal/intermittent saline/brackish/alkaline lakes and flooded areas) - Semi-permanent lakes that completely dry up only during the years in which the El Niño phenomenon occurs.

Laguna Patanca (55 hectares) - with ecological characteristics similar to Laguna Pujzara

Laguna Pasajes (40 hectares) and Laguna Chica (30 hectares) - with chemical and physical characteristics similar to those of Laguna Grande

Seasonal lakes - A group of 17 small-sized lakes (0.5 to 7 hectares) that fill between December and March and disappear during the dry season (April-September).

U (treeless bogs, including bogs with bushes and open bogs, bogs with Graminaea (fen), *bofedales*, low bogs) - The *bofedales* are located in the larger depressions among the low hills where the water table is near the surface and there is permanent ground water. The Tajzara basin has a surface of 1200 hectares of *bofedales* and wet grasslands. The floristic composition in these areas depends on local conditions, above

all the water in the subsoil which allows the development of a very dense vegetative cover, dominated by vegetation in clumps such as *Carex* spp. and *Juncus stipulatus*, rosette grasses such as *Hypochoeris taraxacoides* and *Plantago tubulosa*, plus a few other grasses such as *Deyeuxia heterophylla* (Beck 1999).

This is an important area for the reproduction of several species of high-Andean amphibians such as *Bufo spinulosus*, *Hyla* spp., *Pleurodema cinerea*, *P. marmorata* and *Telmatobius* spp. (A. Muñoz personal communication). Large flocks of Andean geese (*Choloephaga melanoptera*) graze in the *bofedales* in the lower part of this area.

17. Noteworthy flora:

The basin is covered by a low grass, *paja amarilla* (*Stipa leptostachya*). Among the other herbaceous species in this association are *Festuca dolichophylla* and *Stipa leptostachya*. There are also scattered bushes of *Baccharis boliviensis* and *B. incarum*. In the wetter soils, there is open pasture of *Festuca dolichophylla* in association with other smaller Gramineae such as *Deyeuxia breviaristata* and the shrub *Tetraglochin cristatum*. In the areas of saline soil that is seasonally flooded, a low grass of *Muhlenbergia fastigiata* and *Distichlis humilis* grows with clumps of *yaretilla* (*Anthobryum triandrum*).

In the areas where the water table is high, there are vegetative associations called *bofedales*, characterized by the growth of a very dense vegetative cover of *Carex* spp., *Juncus stipulatus* and rosette grasses such as *Hypochoeris taraxacoides* and *Plantago tubulosa*. This area is used for grazing during the dry season when other pastures in the basin are not producing (Beck 1999). The main species of aquatic macrophytes are *Myriophyllum* spp. and *Potamogeton* spp., grazed by cattle which regulate the growth of these grasses (CADIMA 1999).

18. Noteworthy fauna:

The area proposed as a Ramsar site has 40 aquatic species in 12 families. This basin is an important area for the conservation of the following species:

Andean flamingo (*Phoenicopterus andinus*)

Conservation status: vulnerable (Collar, N.J. et al. 1994); a priority species for conservation (Parker, T.A. et al. 1996). Distribution: from Catamarca, Argentina, to Arequipa, Peru, between 2300 and 4300 metres above sea level. The main breeding areas are in the saline lakes of northern Chile (Atacama and Antofagasta) and in the department of Potosí. The world population is estimated to be 35,000 specimens. It is found sporadically in the RBCS, and its presence is conditioned by the water level and salinity of the lakes. There are between 50 and 450 specimens recorded in this area. Conservation: The main threats to this species are the gathering of eggs and pollution of the lakes from mining waste. Because it has very specific feeding requirements,

this species moves from one lake to another following ideal conditions for the production of diatoms. Conservation of the area where this flamingo feeds is important in order to ensure continuous availability of food.

James's flamingo (*Phoenicoparrus jamesi*)

Conservation status: vulnerable (Collar, N.J. et al. 1994); a priority species for conservation (Parker, T.A. et al. 1996). Distribution: mainly above 4000 metres above sea level around lakes with a high salinity. Its main nesting area is in the region of the salt flat and lakes of Coipasa, Poopó and especially Laguna Colorado in Bolivia. Small populations have been recorded around Laguna Pozuelos in Argentina and the Salar de Pedernales. Between 150 and 600 specimens are found in the Laguna Grande in the RBCS. Its presence is irregular in the RBCS and depends on the chemical conditions of the lakes. It has been frequently observed at Laguna Chica, which has a rather high level of salinity. Recently, concentrations of this species have been observed in Laguna Grande (up to 920 specimens, almost 2 per cent of the world population of this species). The low water level of the lake and recent droughts have produced a high concentration of minerals that promote the reproduction of diatoms. This species probably nests around Laguna Chica. Twenty adults and 34 abandoned nests were recorded, but no broken egg shells were found. Although no chicks or juveniles were observed, local inhabitants report the presence of chicks.

Habitat: Shallow lakes with a high concentration of diatoms.

Conservation: The main factors that disturb nesting in the RBCS are the presence of many dogs, sporadic cases of poaching and human presence in the area. Nesting conditions can be improved through environmental education, protecting areas of large concentrations with fences and the elimination of wild dogs in the area.

Soca cornuta (*Fulica cornuta*)

Conservation status: vulnerable (Collar, N.J. et al. 1994); a priority species for conservation (Parker, T.A. et al. 1996). Distribution: Nesting takes place between 3200 and 5200 metres above sea level in the area of the Puna between Jujuy (Argentina) and northern Chile. It is usually rare, but has been recorded sometimes in large numbers around the lakes of northwestern Argentina: 8988 specimens with 180 active nests in the area of Vilama and Polulos in October 1995 (Sandra Caziani and Enrique Derlindati, TWSG News 9: 34-39, 1996) and in Laguna Kastor, Reserva Eduardo Avaroa (Omar Rocha personal communication). It has been often reported in the Reserva Laguna de los Pozuelos (Chebez 1994). It is often reported at Laguna Grande and Laguna Pujzara with numbers varying from several to 1300 specimens. As recent as between November 1998 and July 1999, a steady population of between 300 and 500 specimens was recorded, concentrated at Laguna Pujzara. Although several attempts were reported on 23 October 1997, a group of 36 adults with several couples was reported gathering nesting material but were stopped by specimens of *Fulica gigantea* (Francisco Sagot 1997). Successful nesting of this species in the RBCS has not been confirmed. The population in the RBCS seems to be increasing, and it is hoped that here will be a colony in Laguna Pujzara within a few years.

Habitat: lakes with important communities of aquatic vegetation (*Myriophyllum* spp., *Potamogeton* spp. and *Ruppia* spp.).

19. Social and cultural values:

The wetlands in the Cuenca de Tajzara fulfil an important role for the survival of the grazing systems. The *bofedales* and lakes with macrophytes relieve pressure on the grazing areas during the winter months and form an important biomass reserve in periods of prolonged drought. These activities have an impact on the nesting of several aquatic birds. The grazing of cattle on the macrophytes in Laguna Pujzara make it possible to regulate the growth of these plants in a highly eutrophic environment. An equilibrium has been created between the grazing activities in the area and the life cycles of the lakes. Because of its landscape, the diversity of its fauna and its accessibility, this area is considered to be one of the most important tourist attractions in the department of Tarija. More than 30 archaeological sites have been identified near the lakes, ranging from stone-age cultures of hunters and gathers, to pre-Incan hydraulic structures, rock paintings illustrating aquatic birds and three Incan roads that lead from the basin to the valley. The lakes are mentioned in several legends of the folklore of the Tarija Valley, especially the "Legend of the City of Laguna Grande".

20. Land tenure/ownership of: Most of the land is communal land.

21. Current land use:

The main economic activity in the area is livestock raising (sheep, llamas and cattle). Agriculture is very limited by climatic conditions, although families usually have an average of between one half and one hectare of subsistence crops.

22. Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land use and development projects:

There was formerly pressure from hunting around the lakes, and the eggs of several species of aquatic birds were collected. After creation of the Reserva Biológica Cordillera de Sama and its management by PROMETA these activities disappeared. Among current adverse factors is the presence of many wild dogs in the basin disturbing or preventing nesting of several species of birds. Contamination by domestic waste is limited, but discarded batteries are harming the environment. Trampling by cattle is heavy on the shores of Laguna Pujzara and is a factor limiting the nesting of several species of birds.

23. Conservation measures taken:

There has been a system of guards in the area administered by PROMETA since 1994, with two trained guards on duty. This service has stopped the hunting and the gathering of eggs in the area. PROMETA has been able to participate in trade union

and community meetings in which it provides advice and information on the conservation of ecosystems in the reserve.

24. Conservation measures proposed but not yet implemented:

It is planned to draft a management plan for Lake Pujzara together with the local communities in order to improve the regeneration of pastures and to promote nesting of birds along the shores. The main measure is prohibition of access to parts of the shore during the breeding season, which coincides with the rainy season. There is an environmental education programme directly oriented to the conservation of aquatic birds in the area supported by the American Bird Conservancy. A system for gathering used batteries will be established, and there is a plan to distribute solar panels to several communities.

25. Current scientific research and facilities:

Study of the Ecology of Aquatic Birds in the Cuenca de Tajzara

Study of the Herpetology of the Reserva Biológica Cordillera de Sama (Arturo Muñoz, herpetologist, UMSS)

Management of Natural Resources in the RBCS

Archaeological Survey of the RBCS (Marcos Michel, anthropologist)

Composition, Abundance and Distribution of Phytoplankton in Laguna Grande and Laguna Pujzara in the Department of Tarija (thesis of Judith Mercedes Colque Vázquez; adviser, Mirtha Cadima; Unidad de Limnología y Recursos Acuáticos, Cochabamba)

Structure of Zooplankton in Laguna Grande and Laguna Pujzara in the Department of Tarija (thesis of Carlos Troche; adviser, Mirtha Cadima, Unidad de Limnología y Recursos Acuáticos, Cochabamba)

Structure of the Community of Macro Invertebrates in Laguna Pujzara, Laguna Tajzara and Laguna Grande in the Department of Tarija (Thesis of Estela Herbas Baeny; adviser, Edgar Goitia; Unidad de Limnología y Recursos Acuáticos, Cochabamba)

Existing infrastructure: PROMETA has a centre at Laguna Grande constructed in 1996 with the support of the United Kingdom. This centre can house up to twelve persons and has a bathroom, kitchen and radio.

26. Current conservation education:

A programme of conservation education is being carried out in the Cuenca de Tajzara through talks in union meetings and other opportunities. The Cuenca de Tajzara has a visitors' centre, a birdwatching site, information pamphlets and facilities for school visits. There is a project entitled "Estudios Ecológicos de las Aves Acuáticas de la Cuenca de

Tajzara" with a programme of environmental education focused on the conservation of aquatic birds.

27. Current recreation and tourism: The Department of Tarija, on the periphery of economic growth in Bolivia and off the traditional tourist routes, plays only a minor role in tourism. Nonetheless, the development of roads in the near future and the improvement of communications with Argentina will increase the number of tourists in the area. The Cuenca de Tajzara has, in a limited area, representatives of more than 90 per cent of the high-Andean aquatic birds found in Bolivia. Because of easy access (one hour and a half from the departmental capital on a road open year round) the future of tourism of the Cuenca de Tajzara will be transformed into an important destination for specialized tourism of birdwatching and weekend ecotourism. In addition, almost 8000 years of human occupation are illustrated through many archaeological sites.

28. Jurisdiction:

The Cuenca de Tajzara is part of the Municipio de Yunchara in the province of Avilés in the department of Tarija, Bolivia. Territorial and administrative jurisdiction are the responsibility of the prefecture of the department of Tarija and the Municipio of Yunchara. At the community level, the following organisations are important: Sindicato Agrario, Corregimiento, Junta de Auxilio Escolar and the Tesorero Comunal.

29. Management authority:

This wetland is part of the Reserva Biológica Cordillera de Sama (RBCS), which is managed by the Servicio Nacional de Areas Protegidas through the NGO Protección del Medio Ambiente de Tarija (PROMETA).

30. Bibliographical references: